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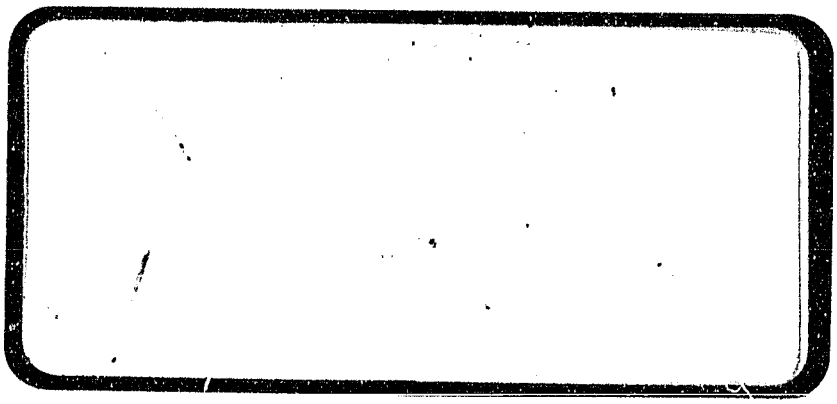

SATELLITE PROVIDED CUSTOMER PREMISES SERVICES: A FORECAST OF POTENTIAL DOMESTIC DEMAND THROUGH THE YEAR 2000

FINAL REPORT - VOLUME I - EXECUTIVE SUMMARY

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16. Abstract

The overall purpose of this study was to forecast the potential United States domestic telecommunications demand for satellite provided customer premises voice, data and video services through the year 2000, so that this information on service demand would be available to aid in NASA program planning.

To accomplish this overall purpose the following objectives were achieved:

a. Development of a forecast of the total domestic telecommunications demand

b. Identification of that portion of the telecommunications demand suitable for transmission by satellite systems

c. Identification of that portion of the satellite market addressable by CPS systems

d. Identification of that portion of the satellite market addressable by Ka-band CPS system.

e. Postulation of a Ka-band CPS network on a nationwide and local level.

The approach employed included the use of a variety of forecasting models, a parametric cost model, a market distribution model and a network optimization model. Forecasts were developed for: 1980, 1990, and 2000; voice, data and video services; terrestrial and satellite delivery modes; and C, Ku and Ka-bands.

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SECTION 1
INTRODUCTION

1.1 BACKGROUND

This report focuses on the results of a study designed to forecast the potential domestic demand for satellite provided customer premises services through the year 2000. It relates to other market demand studies that were performed by Western Union for NASA and that dealt primarily with trunking or fixed communications services (see references 1 and 2* listed in footnote at the end of this section).

This study was conducted because the provision of Customer Premises Services (CPS) has been recently identified as an important offering which could significantly impact the future growth of satellite communications and its advanced technology requirement. CPS is characterized as communications services supplied directly to the customer through small earth terminals located on the customer's premises or through a local customer-shared earth station with dedicated "tail" connections directly to the customer. Many interconnect systems between users and a shared earth station may be viable. While these may range from dedicated to existing or proposed tariffed systems, only dedicated lines were considered for this study.

In order to develop a CPS system that provides a viable alternative to other communications services delivery systems, and to determine the functional and technical requirements of a satellite system to provide such services, it was necessary to know the types, magnitudes, and characteristics of the traffic such a system could be expected to carry in the future. This study was, therefore, undertaken to provide such information. It was performed under NASA contract NAS3-23255.

1.2 PURPOSE AND OBJECTIVES

The overall purpose of this study was:

To forecast the potential United States domestic telecommunications demand for satellite provided customer premises voice, data and video services through the year 2000, so that this information on service demand would be available to aid in NASA communications program planning.

To accomplish this overall purpose the following objectives were achieved for the benchmark years 1980, 1990 and 2000:

a. Development of a forecast of the total domestic telecommunications demand
b. Identification of that portion of the telecommunications demand suitable for transmission by satellite systems
c. Identification of that portion of the satellite market addressable by CPS systems
d. Identification of that portion of the satellite market addressable by Ka-band CPS systems
e. Postulation of a Ka-band CPS network on a nationwide and local level.

For study objectives "a" through "d", future satellite addressable traffic is that telecommunications taffic which could be carried competitively by satellite. It must be emphasized, however, that this future satellite addressable traffic might not, in fact, utilize satellite systems. Study objective "e" deals with that portion of this addressable traffic that is likely to utilize or be captured by CPS satellite systems.

*1. Kratochvil, D.; et. al.: Satellite Provided Fixed Communications Services, A Forecast of Potential Domestic Demand Through the Year 2000. Volume II -Main Text. (Western Union Telegraph Company, NASA Contract No. NAS3-22894): NASA CR-168143, 1983.

2. Gabriszeski, T.; et.el.: 18/30 GHz Fixed Communications System Service Demands Assessment. Volume II - Main Text. (Western Union Telegraph Company, NASA Contract No. NAS3-21359): NASA CR-159547, 1979. (NTIS Accession No. N80-22548).

SECTION 2
APPROACH

Six major tasks were performed to accomplish the overall purpose and objectives of this study. These tasks, which were grouped under the two headings of Market Demand Forecast and CPS Network Traffic Model, were:

Task 1.0 - Market Demand Forecasts
- Task 1.1 - Potential CPS Telecommunications Services
- Task 1.2 - Potential CPS User Classes
- Task 1.3 - Comparative Economics
- Task 1.4 - Market Demand Forecast Development

Task 2.0 - CPS Network Traffic Model
- Task 2.1 - Nationwide Traffic Distribution Model
- Task 2.2 - Intra Urban Topology

The purpose and activities for each of the six major tasks are briefly described. The overall approach and activity flow for the study is depicted in Figure 2-1. Throughout all of the study tasks and activities, considerations was given to the technological, economic and political-social events and trends. Telecommunications literature and user and provider information were continually obtained and reviewed.

2.1 TASK 1.1 - POTENTIAL CPS TELECOMMUNICATIONS SERVICES

The purpose of this task was to identify and characterize those telecommunications services which could be effectively supplied directly to the customer through unshared or shared earth stations. Market studies and the telecommunications literature were reviewed, input was collected from users and providers of telecommunications services, lists of potential services were developed and a final list of services was defined and characterized in terms of dimensions like transmission rates and performance requirements.

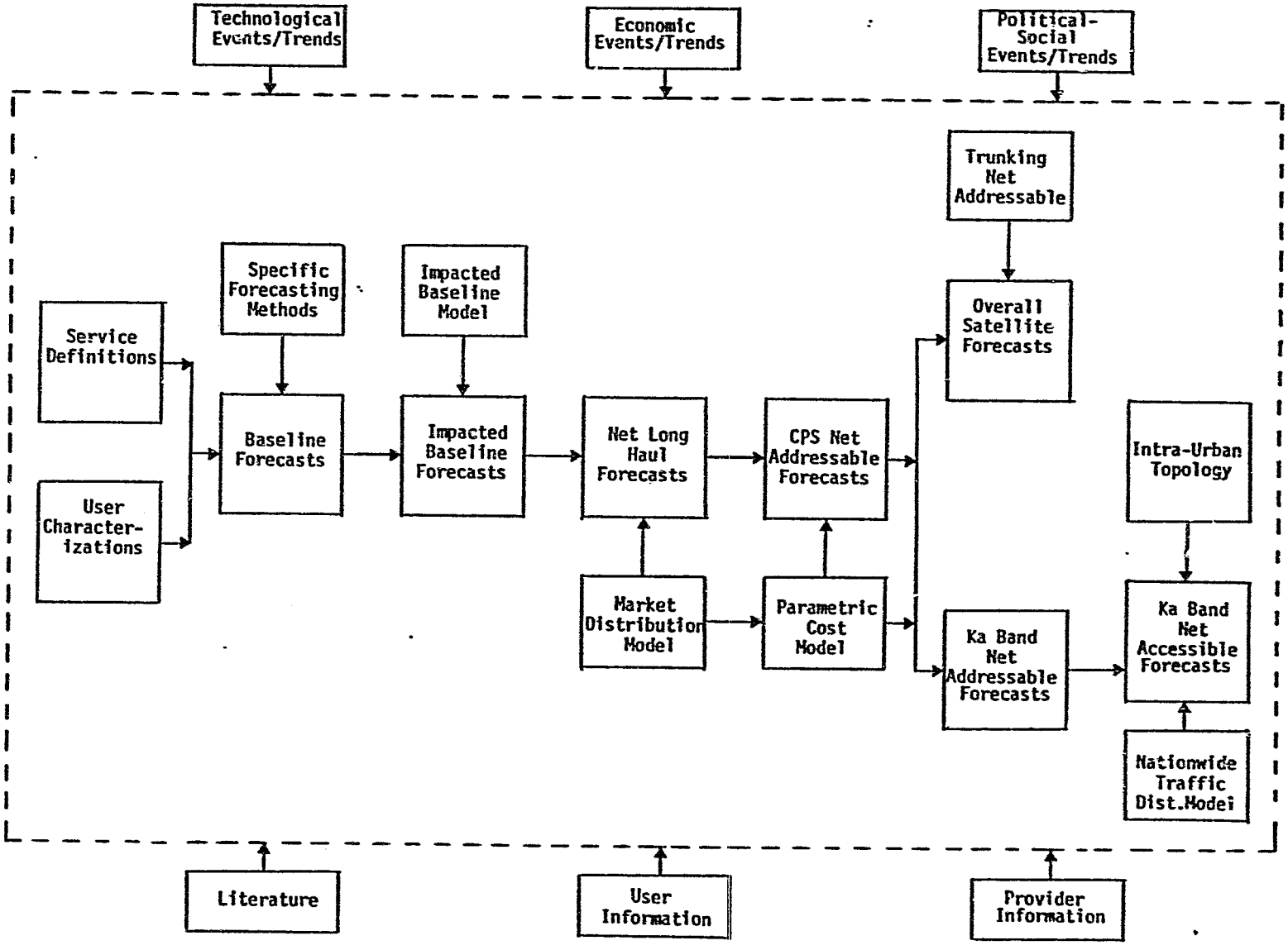


FIGURE 2-1. OVERALL ACTIVITY FLOW FOR THE STUDY

2.2 TASK 1.2 - POTENTIAL CPS USER CLASSES

In this task the classes of potential CPS users were identified and characterized. This involved developing user survey and interview procedures, conducting telephone interviews, analyzing the survey results and characterizing the user classes.

2.3 TASK 1.3 - COMPARATIVE ECONOMICS

The purpose of this task was to develop current and projected service costs to users of various CPS delivery systems and to compare the competitiveness of these systems. CPS space segments, earth stations and terrestrial links were defined and costed, future trends were considered, end-to-end user costs were developed for 1982, 1990 and 2000, and the satellite crossover distances with terrestrial tariffs were calculated for the same bench-mark years. This crossover distance was defined to be that distance at which the terrestrial and satellite transmission costs were the same for a given service. Terrestrial delivery systems included such systems as fiber optics and microwave.

2.4 TASK 1.4 - MARKET DEMAND FORECAST DEVELOPMENT

The purpose of this task was to forecast the overall telecommunications, the overall satellite, the CPS, and the CPS Ka-band market demands for the years 1980, 1990 and 2000.

To develop the overall telecommunications market demand, the baseline, impacted baseline and net long haul forecasts were developed. To develop the baseline forecasts, which were estimates of the current and future volumes of traffic and which reflected the occurrence of expected future events and orderly growth in demand, a specific forecasting methodology was identified and used to forecast each service. Baseline forecasts were in terms of half-voice circuits for voice, terabits per year for data, and transponders for video. The baseline forecasts were then modified by considering the impact of events (technological, economic and social-political) less predictable than those already considered; this modification, which required the development and use of a trend-cross-impact model, resulted in the impacted baseline forecasts. Next, a market

distribution model was developed, traffic which was not considered long-haul was removed, data efficiency factors were considered and traffic estimates were converted to peak hour estimates. Hinterland traffic, defined as that area outside a Standard Metropolitan Statistical Area (SMSA), was retained. The product from these activities was the net long haul forecast.

The CPS net addressable forecast was developed by removing several traffic elements from the net long haul forecast and converting the traffic estimates to equivalent 36 MHz transponders considering future improvements in transponder capacity. The traffic elements removed were: traffic unsuitable for satellite transmission, traffic due to the existing terrestrial plant-in-place, traffic reductions due to time zone considerations, traffic unsuitable for CPS transmission, and traffic less than the crossover distances. While the CPS net addressable forecast represents the total amount of net long haul traffic addressable by a CPS satellite system, the overall satellite forecast represents the total amount of traffic addressable by both CPS and trunking satellite systems which are in direct competition with each other. The trunking forecasts were obtained from a current Western Union study (see reference at the end of Section 1). Based on a comparison of crossover distances on a service, year and satellite band basis, traffic was assigned to either the trunking or CPS segment. The overall satellite forecasts is the sum of the forecast for each segment. As with the CPS net addressable forecast, the Ka-band net addressable forecast was developed by removing similar traffic elements from the net long haul forecast and converting the traffic estimates to transponders. The only differences were: traffic unsuitable for Ka-band CPS transmission and traffic less than the Ka-band crossover was removed. Ka-band forecasts were developed for each of four Ka-band systems: .999 availability and shared/unshared earth stations; .999 availability, unshared earth stations; .995 availability, shared/unshared earth stations, .995 availability, unshared earth stations.

2.5 TASK 2.1 - NATIONWIDE TRAFFIC DISTRIBUTION MODEL

The purpose of this task was to postulate CPS nationwide networks based on the four CPS systems determined by the two design configurations (shared/unshared and unshared) and the two availability levels (.999 and .995) and to describe the corresponding network and model characteristics (e.g., the number and type of

earth stations. The Ka-band net addressable traffic was segmented into classes based on proximity to the central city, traffic models and user models were designed, and forecasts of the Ka-band CPS net accessible (i.e., capturable by a postulated network) traffic were developed.

2.6 TASK 2.2 - INTRA-URBAN TOPOLOGY

The purpose of this task was to describe three traffic nodes based on secondary (i.e., literature review) and primary (i.e., site visit) information so that the results of the nationwide traffic distributions model could be evaluated and refined. Three sites were selected using a variety of criteria (including geography, size, variety of users, and growth trends). Secondary research on the sites was conducted, on-site interviews were conducted with a variety of users, and each node was described in terms of the number, size, and placement of earth stations.

SECTION 3
RESULTS

The study results are described briefly by highlighting the major findings for each of the six study tasks.

3.1 TASK 1.1 - POTENTIAL CPS TELECOMMUNICATIONS SERVICES

The potential CPS telecommunications services are listed in Table 3-1. Thirty-four unique services were identified and grouped under the three major categories of voice, data and video. Sub-groups, for example, broadcast and limited broadcast for the video category, were developed to facilitate selection and use of forecasting methods. While 34 services were described, forecasts were prepared for only 31 of these services; voice-store-and-forward, DBS (Direct Broadcast Satellite) and HDTV (High Definition Television) were treated as market determinant factors when developing the impacted baseline forecasts.

3.2 TASK 1.2 - POTENTIAL CPS USER CLASSES

Information was collected from 253 users representing three major user classes: business, Government and institutions. Subclasses for each were as follows: business-manufacturing, transportation, utilities, retail/wholesale, finance/insurance, professional business services and other; Government-federal, state, local; and institution-education, health, religion. The data collected on each user included interviewee, users, general (e.g., overall budget), CPS, voice, data and video information.

The highlights of the user survey (i.e., the key findings from over 100 tables of data that are presented in the Main Text and Appendices) are presented in Table 3-2.

3.2.1 Sample Description

Of the 253 users interviewed 61 percent, 25 percent and 14 percent, respectively, were business, Government and institutional users. About half the users were classified as large and the other half were about equally divided between

TABLE 3-1. POTENTIAL CPS SERVICES

	GROUPING	SERVICE
VOICE	Message Toll Service	Residential Business
	Other Telephone	Private Line Mobile Radio *Voice Store-and-Forward
	Radio	Public Commercial and Religious Occasional CATV Music Recording Channel
DATA	Terminal Operations	Data Transfer Batch Processing Data Entry Remote Job Entry Inquiry Response Timesharing
	Electronic Mail	USPS EMSS Mailbox Services Administrative Message Traffic Facsimile Communicating Word Processors
	Record Services	TWX/Telex Mailgram/Telegram/Money Order
	Other Terminal Services	Point of Sale Videotex/Teletext Telemonitoring Secure Voice
VIDEO	Broadcast	Network Video CATV Video Occasional Video Recording Channel
	Limited Broadcast	Teleconferencing *DBS *HDTV

*Forecasts were not prepared for those services which were considered as market determinant factors.

TABLE 3-2. HIGHLIGHTS OF USER SURVEY

SAMPLE

Class
Business: 61%
Government: 25%
Institutions: 14%

Size
Large: 52%
Medium: 26%
Small: 22%

Region
9 Regions, varied from 4% to 23% of sample

Urban/Rural
Urban: 45%
Rural: 11%
Both: 44%

BUDGET FOR TELECOMMUNICATIONS SERVICES

1982 - Dollars

Total	Range: $5,000 to $500,000,000;	Mean: $20,020,000
Voice	Range: $5,000 to $300,000,000;	Mean: $15,043,000
Data	Range: $0 to $200,000,000;	Mean: $6,322,000
Video	Range: $0 to $3,000,000;	Mean: $502,000

Growth Rate

Total	Range: -20% to 100%	Mean: 13%
Voice	Range: -20% to 100%	Mean: 11%
Data	Range: -10% to 400%	Mean: 15%
Video	Range: 0% to 300%	Mean: 32%

VOLUME OF TRAFFIC

Growth

Total	Range: -15% to 100%	Mean: 11%
Voice	Range: -10% to 100%	Mean: 9%
Data	Range: -10% to 600%	Mean: 15%
Video	Range: 0% to 600%	Mean: 57%

Reason

Organization Expansion: 26%
More Services: 67%
Both: 7%

PRICE-DEMAND-PERFORMANCE

Use More if Costs Reduced? yes: 61% no: 39%
Reason No: 71% cost insensitive

TABLE 3-2. HIGHLIGHTS OF USER SURVEY (Continued)

PRICE-DEMAND-PERFORMANCE (CONTINUED)

Use Less if Costs Increased? yes: 47% no: 53%
Reason No: 81% cost insensitive

Pay More if Performance Increased? yes: 28% no: 72%
Reason No: 41% limited budget; 44% already satisfactory

Accept Lower Performance if Costs Reduced? yes: 9% no: 91%
Reason No: 91% current is minimal

CUSTOMER PREMISE SERVICE

Use					
	Facilities Suitable?	All: 61%	Some: 30%	None: 9%	
	Currently Using?	Yes: 11%	No: 89%		
	Provider?	SBS: 62%	AMSAT: 38%		
	Currently Considering	Yes: 31%	No: 69%		
	Consider in Future	Yes: 37%	No: 63%		

Features Influencing Use
- Low Cost: 94% (very: 1, 2)
- Reliability: 93% (very: 1, 2)
- High Data Speed: Mixed
- Video Conferencing Capability: Mixed
- Local Loop Solution: Mixed
- Private Ownership: Mixed
- Security: Mixed
- Telco Alternate: Mixed

Actual Results of Use
- Saved Dollars: 87%
- Service Better: 75%
- Productivity Better: 67%

CURRENT AND PLANNED SYSTEM CHARACTERISTICS

New Delivery/Applications Planned

Satellite Services:	2%	High Speed Services:	4%
Fiber Optics:	2%	Video Teleconferencing	24%
Microwave:	2%	DBS:	7%
SBS:	7%	Videotext:	0%
CPS:	4%	Electronic Mail:	3%
Private Networks:	5%	More Services:	28%
Digital Services	6%	None	6%

TABLE 3-2. HIGHLIGHTS OF USER SURVEY (Continued)

CURRENT AND PLANNED SYSTEM CHARACTERISTICS (CONTINUED)

Intra-Inter Needs

Total	Intra:	58%	Inter:	42%
Voice	Intra:	57%	Inter:	43%
Data	Intra:	80%	Inter:	20%
Video	Intra:	89%	Inter:	11%

Current Fastest Channel Data Rate

2.4Kbps	13%
4.8Kbps	14%
9.6Kbps	53%
56Kbps	15%
1.5Mbps	4%
6.3Mbps	1%

Peak Hour

Voice	First:	10:00 - 11:00 AM	48%
	Second:	2:00 - 3:00 PM	51%
Data	First:	Even	37%
	Second:	Even	47%
Video	First:	Even	28%
	Second:	Even	46%

Distribution of Traffic By Distance

Mileage Bands	PCT
40	7.3
41 - 150	15.1
151 - 1000	27.5
1001 - 2100	22.1
2100+	16.4
	11.6

medium and small users. Region representation (regions refer to one of 9 geographic sections of the United States) varied from 4 percent to 23 percent, and about 45 percent had facilities in urban settings and 44 percent in both rural and urban settings.

3.2.2 Budget and Traffic Volume

The average total annual budget for telecommunications services was about twenty million dollars, with business users having the largest average budget. The expected increase in total annual budget was about 13 percent, while the expected increase in volume of services was about 11 percent. About two-thirds of the users indicated that their reason for increasing volume of services was simply the desire for more services.

3.2.3 Price-Demand Permance Relationships

About 61 percent of the users said they would use a greater volume of telecommunications services if costs were reduced. The major reason for not using a greater volume if costs were reduced was that services were cost insensitive. Slightly less than half of the users would use a smaller volume of services if costs were increased. Again, the major reason for not using a lessor volume if costs were reduced was that services were cost insensitive. Less than 30 percent would be willing to pay more for improved performance. The two major reasons users would not pay more was that they were already satisfied and that they had limited budgets. Less than 10 percent would accept a lower level of performance if costs were reduced. The major reason for not accepting a lower performance was that their current level of performance was already minimal.

3.2.4 Customer Premises Services

Over 90 percent of all users indicated that either all or some of their facilities were suitable for a 10 foot earth station. About 11 percent are currently using CPS and in about two-thirds of the cases the provider was Satellite Business Systems. Most said that the early results of using CPS were favorable. Nearly 90 percent said it saved dollars, 75 percent said service was better and about

two-thirds said productivity was better. About a third of those not currently using CPS are considering CPS for future use. Businesses indicated the greatest likelihood of future use. The major reason for considering future use was the need to cut costs. Of some nine features that might influence future use of CPS, users indicated that five were important: low cost, reliability, need for high data rates, security and a need for an alternative to Telco.

3.2.5 Current and Planned System Characteristics

A variety of new delivery/applications are planned, with the most frequently mentioned addition being video teleconferencing; currently about 15 percent of the users have this service. Voice services are needed slightly more for intra-organizational needs than for inter-organizational needs, while data and video services are needed significantly more for intra-organizational needs. Users' typical fastest data rate is 9.6 kbps. Voice has two peak hours (10-11 a.m. and 2-3 p.m.) while data and video are even throughout the day. About 50 percent of the traffic of users falls between 151 and 1000 miles.

3.3 TASK 1.3 - COMPARATIVE ECONOMICS

The key findings from the economic analysis are presented in Tables 3-3 through 3-8. These tables include summary information taken from the over 125 tables and figures included in the economic analysis sections of the Main Text and Appendices. The key assumptions that were made are discussed in the Main Text.

3.3.1 Earth Station Costs

The current and projected earth station costs, in thousands of 1982 dollars, are presented in Table 3-3. Costs are presented by band, earth station capacity, availability level and year. The costs of all earth stations are expected to decline continually from 1982 to 2000. In all cases earth stations with .999 availability cost significantly more than those with .995 availability. Also, Ka-band TDMA earth stations are expected to be less expensive than FDMA earth stations.

TABLE 3-3. CURRENT AND PROJECTED EARTH STATION COSTS
(Thousands of 1982 Dollars)

BAND	ES CAPACITY	AVAILABILITY	YEAR 1982	1990	2000
	32 Mbps	.995	678	405	258
		.999	964	557	351
	6.3 Mpbs	.995	258	151	96
		.999	475	289	185
	1.5 Mbps (TDMA)	.995	220	129	81
		.999	393	240	154
	.15 Mbps (SCPC)	.995	,4	70	47
		.999	115	151	102
	Mini	.995	64	45	31
		.999	137	99	67
Ku	32 Mbps	.995	539	298	184
		.999	900	504	316
	6.3/1.5 Mbps	.995	396	252	163
		.999	725	435	287
	1.5 Mbps/	.995	449	300	198
	64 Kbps	.999	586	391	259
	1.5 Mbps	.995	241	179	123
		.999	396	304	208
	64 Kbps	.995	190	144	99
		.999	404	300	206
Ka	32 Mbps				
	FDMA	*	---	969/830**	715/612**
	TDMA	*	---	330	243
	6.3 Mbps				
	FDMA	*	---	471/359**	547/265**
	TDMA	*	---	233	172
	1.5 Mbps				
	FDMA	*	---	329/165**	243/122**
	TDMA	*	---	208	153
	64 Kbps				
	FDMA	*	---	95/85**	70/63**
	TDMA	*	---	109	80

*.995 Availability in Rain Zone E and .999 in other areas.
**First cost for 1.2 degree spacecraft beams, second for .3.

3.3.2 Satellte Investment Costs

The current satellite investment costs, in millions of 1982 dollars, are indicated in Table 3-4. Costs are noted by element and by band. Elements include development, satellite recurring, launch, insurance, TT&C and ground spare costs. The cost of C-band satellites are expected to stay at the same level as they are today since these satellites have been used for over a decade and technology seems to have matured. Since the Ku-band technology is not mature, the cost of Ku-band satellite is expected to decline at a rate of 3.5 percent per year until the year 2000. For Ka-band, it is expected that the satellite cost in year 2000 will remain the same as in year 1990 (i.e., the costs indicated for Ka-band in Table 3-4).

3.3.3 Composite Crossover Distances

Using estimates of the earth station and satellite costs and Western Union's financial packages, payoff requirements and crossover distances were developed for C-, Ku- and Ka-bands by shared/unshared and unshared configurations, by .995 and .999 availability levels, by earth station capacity and by operating speed. These crossover distances were then used to develop composite crossovers. A composite crossover distance was defined as the weighted sum of the individual crossover distances of the various types of earth stations. The composite crossover distances by band, by year, by operating speed and by system configuration are presented in Tables 3-5 through 3-8.

In 1982, C-band had a lower crossover distance than Ku-band for all four configurations (i.e., shared or unshared with .999 or .995 availability). For 1990 and 2000 for all unshared systems (i.e., with .999 and .995 availability), the crossover distance for Ka-band will be lowest. In 1990 and 2000 for the shared system with .999 availability, the crossover distances for Ku-band will be lowest. In 1990 for the shared system with .995 availability, the crossover distances for C-band will be lowest. In 2000 for the shared system with .995 availability, the crossover distances for Ku-band will be lowest. That is, the crossover distances for Ka-band, as compared with those of C- and Ku-bands, will be the lowest for unshared systems and the highest for shared systems in 1990 and 2000.

TABLE 3-4. CURRENT SATELLITE INVESTMENT COST*
(IN MILLIONS OF 1982 DOLLARS)

			KA-BAND (TDMA)		
COST ELEMENTS	C-BAND	KU-BAND	3 Gbps	5 Gbps	10 Gbps
Development (NR)	0.0	34.0	180.0	220.0	280.0
2(R+L+IN)	156.0	163.8	--	--	--
1(R+L+IN)	--	--	74.9	86.6	110.0
TT&C	15.0	15.0	40.0	40.0	40.0
R	30.0	35.7	40.0	50.0	70.0
TOTAL	210.0	248.5	334.9	396.6	500.0

R = Satellite Recurring Cost
L = Launch Cost
IN = Insurance Cost
TT&C = Telemetry Tracking and Command

*Costs for C- and Ku-bands are current 1982 costs, while those for Ka-band are estimated costs for 1990 when the first Ka-band system is expected to be operational.

TABLE 3-5. COMPOSITE CROSSOVER DISTANCE IN MILES
UNSHARED EARTH STATIONS .999 AVAILABILITY

YEAR/BAND	OPERATING SPEEDS (kbps) 2.4	4.8	9.6	56	T1 (1544)	V1 (64)	V2 (64)	V3 (64)
1982								
C	62	114	252	332	367	4066	3825	3640
KU	123	231	491	631	525	6461	6116	5856
1990								
C	19	41	127	194	292	2938	2738	2565
KU	51	137	334	440	316	4607	4338	4129
KA	5	15	42	92	205	2006	1824	1659
2000								
C	7	23	61	121	248	2318	2125	1978
KU	28	68	198	283	204	3069	2842	2661
KA	1	1	6	46	118	1283	1134	1007

TABLE 3-6. COMPOSITE CROSSOVER DISTANCE IN MILES
UNSHARED EARTH STATIONS .995 AVAILABILITY

YEAR/BAND	OPERATING SPEEDS (kbps) 2.4	4.8	9.6	56	T1 (1544)	V1 (64)	V2 (64)	V3 (64)
1982								
C	32	48	115	163	284	2724	2535	2374
KU	98	195	419	525	376	5274	4977	4764
1990								
C	7	19	45	93	237	2096	1919	1779
KU	41	103	266	359	245	3731	3488	3298
KA	5	15	42	92	204	2003	1820	1655
2000								
C	1	4	17	47	222	1703	1536	1389
KU	20	50	146	222	140	2405	2237	2142
KA	1	1	6	45	117	1279	1130	1004

TABLE 3-7. COMPOSITE CROSSOVER DISTANCE IN MILES SHARED EARTH STATIONS .999 AVAILABILITY

	OPERATING SPEEDS (kbps)							
YEAR/BAND	2.4	4.8	9.6	56	T1 (1544)	V1 (64)	V2 (64)	V3 (64)
1982								
C	692	953	1628	619	185	956	820	688
KU	705	982	1715	682	287	1454	1305	1156
1990								
C	411	653	1056	535	177	872	758	645
KU	409	649	1048	516	167	805	683	595
KA	481	776	1228	618	173	875	750	652
2000								
C	288	502	854	419	119	564	442	336
KU	287	498	846	410	106	512	390	307
KA	410	713	1023	581	109	579	457	346

TABLE 3-8. COMPOSITE CROSSOVER DISTANCE IN MILES SHARED EARTH STATIONS .995 AVAILABILITY

	OPERATING SPEEDS (kbps)							
YEAR/BAND	2.4	4.8	9.6	56	T1 (1544)	V1 (64)	V2 (64)	V3 (64)
1982								
C	688	946	1603	601	154	800	689	587
KU	697	965	1667	647	227	1143	1004	862
1990								
C	402	634	1018	481	123	619	505	400
KU	404	639	1028	493	139	684	671	463
KA	481	775	1227	618	171	870	745	647
2000								
C	289	503	856	421	121	575	453	344
KU	283	490	832	393	82	415	303	224
KA	409	713	1022	579	108	574	452	341

3.4 TASK 1.4 - MARKET DEMAND FORECAST DEVELOPMENT

The major forecasts from the baseline through the net addressable forecasts are presented in Table 3-9. The corresponding growth rates are indicated in Table 3-10. Each of the major forecasts are described briefly in terms of purpose and findings.

3.4.1 Baseline Forecasts

Baseline forecasts are estimates of the current and future volumes of traffic and reflect the occurrence of expected events and orderly growth in demand. These forecasts were developed for 31 voice, data and video services for the years 1980 through 2000. In Table 3-9 the voice, data and video baseline forecasts are indicated, respectively, in thousands of half voice circuits, terabits per year, and transponders. The baseline growth rates in Table 3-10 show that data traffic will be growing about 14 percent per year from 1980 to 2000 and that voice and video each will be growing at slightly less than 10 percent per year.

3.4.2 Impacted Baseline Forecasts

The impacted baseline forecasts were developed by considering the impact of less predictable events or market determinant factors on the baseline forecasts. As shown in Table 3-11, leaders in the telecommunications industry estimated that half of the events considered in this study would occur by 1995, and all but one, biochips, would occur by 2005. The expected impact of these events is indicated in Table 3-9 where the voice, data and video impacted baseline forecasts are again presented, respectively, in thousands of half voice circuits, terabits per year, and transponders. The impact varied from -1.5 percent to 27 percent across services. As shown in Table 3-10, the growth rates for the impacted baseline were very similar to those for the baseline.

3.4.3 Net Long Haul Forecasts

The net long haul forecasts were developed by removing several traffic elements from the impacted baseline forecasts and converting traffic estimates to peak

TABLE 3-9. SUMMARY OF FORECASTS

FORECASTS	YEAR		
	1980	1990	2000
BASELINE			
Voice (1000s HVCs i.e., Half Voice Circuits)	2,829	8,045	18,405
Data (Terabits/Year)	1,892	9,084	26,879
Video (Transponders)	66	309	312
IMPACTED BASELINE			
Voice (1000s HVCs)	2,829	8,227	19,876
Data (Terabits/Year)	1,892	9,840	31,103
Video (Transponders)	66	337	406
NET LONG HAUL			
Voice (1000s HVCs)	2,524	7,635	18,686
Data (Mbps)	15,165	31,279	40,344
Video (Transponders)	61	323	393
CPS SATELLITE (TRANSPONDERS)			
Voice	.9	17	100
Data	21.5	200	529
Video	.3	52	109
TOTAL	23.0	269	738
OVERALL SATELLITE (TRANSPONDERS)			
TRUNKING SEGMENT			
Voice	190	601	1,806
Data	0	3	13
Video	61	323	393
TOTAL	251	927	2,212
CPS SEGMENT			
Voice	0	3	18
Data	22	202	529
Video	0	10	20
TOTAL	22	215	567
TOTAL			
Voice	190	605	1,824
Data	22	204	542
Video	61	333	413
TOTAL	273	1,142	2,779
KA-BAND CPS SATELLITE (TRANSPONDERS) SHARED-UNSHARED/.999			
SERVICE CATEGORIES			
Voice	--	14 (6%)	85 (14%)
Data	--	176 (78%)	450 (74%)
Video	--	35 (16%)	78 (12)
TOTAL	--	225	608

TABLE 3-9. SUMMARY OF FORECASTS (CONTINUED)

	1980	1990	2000
USER CLASSES			
Business	--	111 (49%)	301 (49%)
Government	--	35 (16%)	94 (16%)
Institutions	--	74 (33%)	201 (33%)
Private	--	5 (2%)	12 (2%)
TOTAL	--	225	608
MILEAGE BANDS			
1-40	--	12 (6%)	34 (6%)
41-150	--	33 (15%)	89 (15%)
151-500	--	70 (31%)	190 (31%)
501-1000	--	62 (27%)	167 (27%)
1001-2100	--	39 (17%)	105 (17%)
2101+	--	9 (4%)	23 (4%)
TOTAL	--	225	608
SHARED-UNSHARED/.995			
SERVICE CATEGORIES			
Voice	--	13 (6%)	77 (14%)
Data	--	158 (78%)	405 (74%)
Video	--	31 (16%)	66 (12%)
TOTAL	--	202	548
USER CLASSES			
Business	--	100 (49%)	271 (50%)
Government	--	31 (16%)	85 (15%)
Institutions	--	66 (33%)	181 (33%)
Private	--	5 (2%)	11 (2%)
TOTAL	--	202	548
MILEAGE BANDS			
1-40	--	11 (6%)	30 (6%)
41-150	--	29 (15%)	80 (15%)
151-500	--	63 (31%)	171 (31%)
501-1000	--	56 (27%)	151 (27%)
1001-2100	--	35 (17%)	95 (17%)
2101+	--	8 (4%)	21 (4%)
TOTAL	--	202	548
UNSHARED/.999			
SERVICE CATEGORIES			
Voice	--	3 (1%)	28 (5%)
Data	--	176 (82%)	450 (82%)
Video	--	35 (17%)	73 (13%)
TOTAL	--	213	551

TABLE 3-9. SUMMARY OF FORECASTS (CONTINUED)

	1980	1990	2000
USER CLASSES			
Business	--	104 (49%)	266 (48%)
Government	--	33 (16%)	88 (16%)
Institution	--	71 (33%)	185 (34%)
Private	--	5 (2%)	12 (2%)
TOTAL	--	213	551
MILEAGE BANDS			
1-40	--	12 (6%)	31 (6%)
41-150	--	31 (15%)	80 (15%)
151-500	--	67 (31%)	172 (31%)
501-1000	--	59 (27%)	152 (27%)
1001-2100	--	36 (17%)	95 (17%)
2100+	--	8 (4%)	21 (4%)
TOTAL	--	213	551
UNSHARED/.995			
SERVICE CATEGORIES			
Voice	--	2 (1%)	25 (5%)
Data	--	158 (82%)	405 (82%)
Video	--	31 (17%)	66 (13%)
TOTAL	--	192	496
USER CLASSES			
Business	--	93 (49%)	240 (48%)
Government	--	30 (16%)	79 (16%)
Institution	--	64 (33%)	166 (34%)
Private	--	5 (2%)	11 (2%)
TOTAL	--	192	496
MILEAGE BANDS			
1-40	--	11 (6%)	27 (6%)
41-150	--	28 (15%	72 (15%)
151-500	--	60 (31%)	155 (21%
501-1000	--	53 (27%)	137 (27%)
1001-2100	--	33 (17%)	86 (17%)
2101+	--	7 (4%)	19 (4%)
TOTAL	--	192	496

TABLE 3-10. SUMMARY OF GROWTH RATES (%)

FORECASTS	TIME PERIODS		
	1980-1990	1990-2000	1980-2000
BASELINE			
Voice	11.0	8.6	9.8
Data	17.0	11.5	14.2
Video	16.7	.1	8.1
IMPACTED BASELINE			
Voice	11.3	9.2	10.2
Data	17.9	12.2	15.0
Video	17.7	1.9	9.5
NET LONG HAUL			
Voice	11.7	9.4	10.5
Data	7.5	2.6	5.0
Video	18.1	2.0	9.7
CPS SATELLITE			
Voice	24.0	19.6	26.6
Data	25.0	10.2	17.4
Video	67.5	7.7	34.3
TOTAL	28.1	10.6	19.0
OVERALL SATELLITE			
TRUNKING SEGMENT			
Voice	12.3	11.6	11.9
Data	40.0	16.0	27.5
Video	18.1	2.0	9.7
TOTAL	14.0	9.1	11.5
CPS SEGMENT			
Voice	31.5	19.5	25.4
Data	25.0	10.1	17.3
Video	57.8	7.6	30.3
TOTAL	25.6	10.2	17.6
TOTAL			
Voice	12.3	11.7	12.0
Data	25.1	10.2	17.4
Video	18.4	2.2	10.0
TOTAL	15.4	9.3	12.3
KA-BAND CPS SATELLITE			
SHARED-UNSHARED/.999			
SERVICE CATEGORIES			
Voice	--	19.6	--
Data	--	9.9	--
Video	--	7.6	--
TOTAL	--	10.5	--

TABLE 3-10. SUMMARY OF GROWTH RATES (%) (CONTINUED)

	1980-1990	1990-2000	1980-2000
USER CLASSES			
Business	--	10.5	--
Government	--	10.4	--
Institutions	--	10.5	--
Private	--	9.1	--
TOTAL	--	10.4	--
MILEAGE BANDS			
1-40	--	11.0	--
41-150	--	10.4	--
151-500	--	10.5	--
501-1000	--	10.4	--
1001-2100	--	10.4	--
2101+	--	9.8	--
TOTAL	--	10.4	--
SHARED-UNSHARED/.995			
SERVICE CATEGORIES			
Voice	--	19.5	--
Data	--	9.9	--
Video	--	7.8	--
TOTAL	--	10.5	--
USER CLASSES			
Business	--	10.5	--
Government	--	10.6	--
Institutions	--	10.6	--
Private	--	8.2	--
TOTAL	--	10.5	--
MILEAGE BANDS			
1-40	--	10.6	--
41-150	--	10.7	--
151-500	--	10.5	--
501-1000	--	10.4	--
1001-2100	--	10.5	--
2101+	--	10.1	--
TOTAL	--	10.5	--
UNSHARED/.999			
SERVICE CATEGORIES			
Voice	--	25.0	--
Data	--	9.8	--
Video	--	7.6	--
TOTAL	--	10.0	--

TABLE 3-10. SUMMARY OF GROWTH RATES (%) (CONTINUED)

	1980-1990	1990-2000	1980-2000
USER CLASSES			
Business	--	9.8	--
Government	--	10.3	--
Institution	--	10.1	--
Private	--	9.1	--
TOTAL	--	10.0	--
MILEAGE BANDS			
1-40	--	10.0	--
41-150	--	9.9	--
151-500	--	9.9	--
501-1000	--	9.9	--
1001-2100	--	10.2	--
2101+	--	10.1	--
TOTAL	--	10.0	--
UNSHARED/.995			
SERVICE CATEGORIES			
Voice	--	28.7	--
Data	--	9.9	--
Video	--	7.8	--
TOTAL	--	10.0	--
USER CLASSES			
Business	--	9.9	--
Government	--	10.2	--
Institution	--	10.0	--
Private	--	8.2	--
TOTAL	--	10.0	--
MILEAGE BANDS			
1-40	--	9.4	--
41-150	--	9.9	--
151-500	--	10.0	--
501-1000	--	10.0	--
1001-2100	--	10.1	--
2101+	--	10.5	--
TOTAL	--	10.0	--

TABLE 3-11. MARKET DETERMINANT FACTORS THAT ARE VERY LIKELY TO OCCUR BY 1995 AND 2005.

	MARKET DETERMINANT FACTORS (MDFs)	VERY CERTAIN OR 100% CHANCE OF OCCURRING BY: 1995	2005
1	TOUCH INPUT DEVICES	X	
2	SMART CARDS	X	
3	VOICE RECOGNITION		X
4	HAND HELD TERMINALS	X	
5	NON-IMPACT PRINTING		X
6	FLAT OUTPUT PANELS		X
7	MICROPROCESSOR IMPROVEMENT	X	
8	MICROMEMORIES IMPROVEMENT	X	
9	BIOCHIPS		
10	FIFTH GENERATION COMPUTERS		X
11	ARTIF. INTEL. EXP. MACHINES		X
12	SELF-PROGRAMMING COMPUTERS		X
13	UNIVERSAL PROGRAMMING LANGUAGE		X
14	TERMINAL/COMPUTER COMPATIBILITY	X	
15	STANDARDIZATION OF SOFTWARE		X
16	DIRECT BROADCAST SERVICE	X	
17	HIGH DEFINITION TELEVISION	X	
18	VOICE STORE AND FORWARD	X	
19	WRIST RADIO		X
20	ANTENNA MATERIAL IMPROVEMENT	X	
21	SATELLITE MATERIAL IMPROVEMENT		X
22	FIBER OPTICS	X	
23	GEO-STATIONARY PLATFORM		X
24	PROSPERITY	X	
25	RECESSION/DEPRESSION	X	
26	COMMUNICATIONS BUSINESS SHAKEDOWN	X	
27	RESOURCES - CRITICAL NEED	X	
28	GLOBAL ECONOMY		X
29	INDUSTRIES IN SPACE		X
30	DOMESTIC INTERNATIONAL SATELLITE		X
31	LIMITED WARS	X	
32	ORBIT SHARE CONFLICT	X	
33	ACCEPTANCE OF TECHNOLOGY	X	
34	WORK AT HOME		X
35	SATELLITE IMPORTATION OF WORKERS		X
36	SELF-HELP		X

hour estimates. Also efficiency factors on a year-to-year, service-by-service basis were applied to the data forecasts to account for the various inefficiencies of data transmission. These inefficiencies include idle line time, protocol overheads, call-setup and breakdown and other factors. The net long haul forecasts are presented in Table 3-9 where voice, data and video forecasts are indicated, respectively, in thousands of half voice circuits, megabits per second (Mbps) and transponders. As shown in Table 3-10, the growth rates for the voice and video net long haul forecasts are about 10 percent per year from 1980 to 2000, while the growth rate for data for the same period is only about five percent.

3.4.4 CPS Satellite Forecast

The CPS satellite forecasts represents the total amount of traffic addressable by a CPS, stand-alone (i.e., competition from trunking systems was not considered) system. Table 3-9 indicates that data accounts for most of the CPS traffic for all years. Note that the voice, data and video forecasts can be compared now that they are in like units, transponders. The growth rate, as shown in Table 3-10, is expected to be the greatest for video services (i.e., around 34 percent per year), and the lowest for data (i.e., around 17 percent). Still, the amount of data traffic in 2000 will be about five times that of voice or video.

3.4.5 Overall Satellite Forecasts

The overall satellite forecasts were developed by integrating the CPS and Trunking forecasts. Figure 3-1 indicates the relationship between these two forecasts. Table 3-9 presents the actual forecasts for these two segments of the overall satellite forecasts. It is clear that trunking will dominate the overall satellite market through the year 2000. However, its share of the overall satellite market is projected to decline from 92 percent in 1980 to 80 percent by 2000. The growth rates for the overall satellite market are shown in Table 3-10 and indicate that data traffic will be growing about 17 percent per year through the year 2000 and voice and video will be growing about 10-12 percent per year.

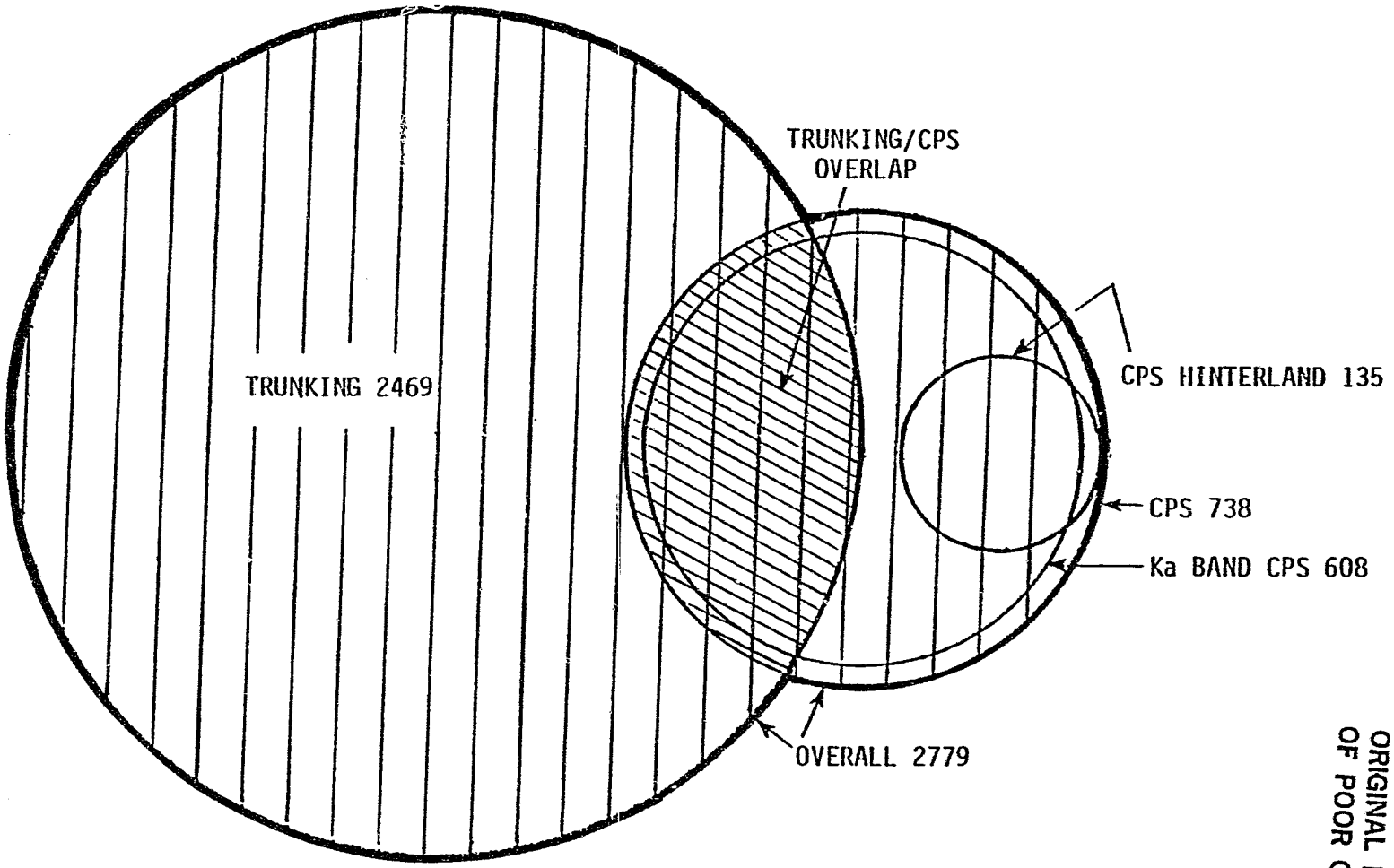


FIGURE 3-1. INTEGRATION OF CPS AND TRUNKING FORECASTS IN DEVELOPMENT OF OVERALL SATELLITE FORECAST (NUMBERS = # TRANSPONDERS IN 2000)

3.4.6 Ka-Band CPS Satellite Forecasts

The Ka-band CPS satellite forecasts represent the total amount of traffic addressable by a Ka-band CPS satellite system. These forecasts were developed by service, user class, mileage band, geographic region and various combinations of these groupings. The highlights of these forecasts are presented in Table 3-9 and the corresponding growth rates appear in Table 3-10. Forecasts were not developed for 1980 since Ka-band systems will not be operating until around 1990. Of the Ka-band addressable traffic, about three-fourths will be data traffic, about half will for business communications, and a majority of the traffic will be transmitted between 151 and 1000 miles. The total forecast is the largest for the shared/unshared configuration with .999 availability and it is the smallest for the unshared configuration with .995 availability. The total forecasts were similar for the shared/unshared configuration with .995 availability and the unshared configuration with .999 availability. The growth rates for all systems are expected to be around 10 percent per year from 1990 to 2000.

3.5 NATIONWIDE TRAFFIC DISTRIBUTION MODEL

An example of the reports generated by the nationwide traffic distribution model is indicated in Table 3-12 which shows the top 50 SMSAs (including state hinterlands) for the .999 shared/unshared system in the year 2000. Column 1 is the order in which the SMSA or the group of cities comprising the states hinterlands ranks when the amount of traffic which could be captured by a nationwide CPS network in the year 2000 is used. Column 2 presents the SMSA or state (in addition, states include a " " to easily identify them). Column 3 is the amount of traffic expected to be captured. The next four columns show the number of each type of earth station to expect in each location. The next three columns show the amount of traffic by service type which was either transmitted or terminated within a particular area. The next column is a summary of the traffic allocated to a specific area. The captured column is the ratio of the traffic captured to the total amount of traffic allocated. The number of square miles in the metropolitan area is given in the next column. The last column gives the number of square miles in the central city.

TABLE 3-12. TOP 50 SMSA'S (INCLUDING STATE HINTERLANDS) FOR THE .999 SHARED/UNSHARED SYSTEM

.999 SHARED/UNSHARED

		CAPTURED MBPS	LRG ES	MED ES	SML ES	MINI ES	VOICE MBPS	DATA MBPS	VIDEO MBPS	TOTAL MBPS	CAPTURED PCT	METRO SQ MI	CITY SQ MI
1	NEW YORK NY-NJ	692.60	2	139	297	4	833.03	66.25	460.18	1300.25	50.18	1384	237
2	CHICAGO IL	347.10	3	64	130	6	529.30	41.00	285.32	855.76	40.56	3500	140
3	LOS ANGELES-LONG BEA	259.25	2	50	93	4	347.53	26.97	187.30	561.80	46.15	3500	140
4	PHILADELPHIA PA-NJ	153.75	0	15	142	4	305.92	23.74	164.88	494.53	31.09	3500	140
5	DETROIT MI	144.75	0	15	130	3	279.77	21.71	150.78	452.26	32.01	3500	140
6	WASHINGTON DC-MD	130.60	0	14	126	4	262.70	20.38	141.58	424.66	32.64	2012	146
7	BOSTON MA	92.70	0	3	111	3	189.74	14.72	102.26	306.73	30.22	1233	200
8	BALTIMORE MD	87.15	0	6	91	2	176.80	13.72	95.29	285.81	30.49	2259	138
9	HOUSTON TX	86.55	0	7	86	3	179.74	13.95	96.87	290.57	29.79	3500	140
10	ATLANTA GA	85.65	0	6	89	2	160.47	12.45	86.48	259.40	33.02	3500	140
11	MINNEAPOLIS-ST PAUL	82.95	0	8	77	3	169.95	13.19	91.60	274.74	30.19	3500	140
12	DALLAS-FORT WORTH TX	82.05	0	7	80	3	155.87	12.09	84.01	251.97	32.56	3500	140
13	NASSAU-SUFFOLK NY	79.95	0	3	94	2	160.55	13.00	90.84	272.47	29.34	1218	202
14	ST LOUIS MO-IL	79.95	0	8	73	2	150.13	12.27	85.22	255.62	31.28	3500	140
15	CLEVELAND OH	76.35	0	9	64	2	169.48	13.15	91.34	273.98	27.87	1519	112
16	MILWAUKEE WI	70.20	0	3	81	2	134.79	10.46	72.65	217.90	32.22	1475	161
17	NEWARK NJ	69.15	0	1	80	2	130.13	10.10	70.14	210.37	32.87	1008	217
18	PITTSBURGH PA	67.65	0	6	65	2	178.28	13.83	96.08	288.19	23.47	3049	146
19	SAN FRANCISCO-OAKLAN	67.50	0	5	69	3	128.32	9.96	69.16	207.43	32.54	2480	143
20	DENVER-BOULDER CO	58.50	0	5	57	2	106.69	8.28	57.50	172.47	33.92	3500	140
21	CINCINNATI OH-KY	55.50	0	5	53	2	133.32	10.34	71.85	215.52	25.75	2149	136
22	JERSEY CITY NJ	53.25	0	15	0	0	56.78	4.41	30.60	91.79	58.01	47	21
23	MIAMI FL	50.25	0	5	46	1	92.09	7.15	49.63	148.86	33.76	2042	133
24	KANSAS CITY MO-KS	47.55	0	2	55	2	105.69	8.20	56.96	170.85	27.83	3341	143
25	* NEW YORK	42.75	0	0	57	0	173.14	13.43	93.31	279.88	15.27	6	
26	COLUMBUS OH	42.30	0	2	48	2	110.20	8.55	59.40	178.15	23.74	2459	142
27	NEW HAVEN-WEST HAVEN	42.15	0	1	52	1	74.50	5.79	40.19	120.56	34.96	337	125
28	INDIANAPOLIS IN	38.70	0	3	39	2	117.13	9.09	63.13	189.34	20.44	3072	145
29	MERIDEN CT	35.40	0	6	22	0	41.26	3.20	22.24	66.71	53.07	24	24
30	BUFFALO NY	33.60	0	4	28	2	99.84	7.75	53.31	161.39	20.82	1590	116
31	DAYTON OH	29.55	0	2	31	2	84.99	6.59	45.80	137.39	21.51	1707	121
32	NEW ORLEANS LA	29.55	0	2	31	1	85.92	6.67	46.31	138.90	21.27	1966	130
33	LOUISVILLE KY-IN	29.25	0	0	39	2	95.25	7.39	51.33	153.97	19.00	1392	174
34	BRIDGEPORT CT	29.25	0	0	39	1	62.00	4.87	33.85	101.52	28.81	198	120
35	AKRON OH	28.50	0	0	38	2	72.85	5.65	39.26	117.77	24.20	903	216
36	TAMPA-ST PETERSBURG	28.05	0	2	29	1	74.27	5.76	40.03	120.06	23.36	2045	133
37	BRISTOL CT	27.90	0	6	12	0	41.16	3.19	22.18	66.53	41.93	79	34
38	SAN DIEGO CA	27.30	0	2	28	1	78.91	6.12	42.53	127.56	21.40	3500	140
39	OKLAHOMA CITY OK	27.30	0	2	28	1	76.56	5.94	41.26	123.76	22.06	3491	140
40	MEMPHIS TN-AR	25.80	0	2	26	2	81.61	6.33	43.99	131.93	19.56	2298	139
41	PHOENIX AZ	25.80	0	2	26	1	72.68	5.64	39.17	117.50	21.96	3500	140
42	HARTFORD CT	25.50	0	0	34	2	87.23	6.77	47.01	141.01	18.08	1032	216
43	PROVIDENCE-WARWICK-P	25.50	0	0	34	2	77.78	6.04	41.92	125.74	20.28	747	206
44	SEATTLE-EVERETT WA	25.05	0	2	25	1	66.79	5.18	36.00	107.96	23.20	3500	140
45	BIRMINGHAM AL	24.90	0	1	29	2	76.62	5.95	41.29	123.86	20.10	3358	142
46	SPRINGFIELD-CHICOPEE	24.75	0	0	33	2	66.66	5.17	35.93	107.75	22.97	633	191
47	ROCHESTER NY	24.15	0	1	28	2	86.69	6.73	46.72	140.13	17.23	2966	146
48	TULSA OK	24.15	0	1	28	1	66.48	5.16	35.83	107.47	22.47	3500	140
49	TOLEDO OH-MI	23.25	0	0	31	2	76.64	5.95	41.30	123.89	18.77	2187	137
50	NEW BRUNSWICK-PERTH	23.25	0	0	31	1	61.31	4.76	33.05	99.12	23.46	312	110

A criticial point to be made from this analysis is that users and therefore traffic is dispersed differently throughout the United States. Central cities are highly concentrated while the area outside but still within the SMSA has diminishing traffic. Hinterland traffic is both concentrated in small cities and dispersed in villages and towns across rural America. These locations vary greatly across the U.S. and it is necessary to gather facts about each SMSA (artificial or real) in order to make a good approximation of the user and traffic concentrations.

Figure 3-2 indicates the actual amount of the Ka-band CPS addressable traffic that would be captured (i.e., that would be accessible) by each of the network postulated for the four Ka-band systems in 2000. The 19, 17, 20 and 18 percents represent, respectively, 113, 93, 110 and 90 36 MHz transponders.

3.6 INTRA-URBAN TOPOLOGY

Based on secondary and primary research (i.e., site visit) information, three traffic nodes, Boston, Denver and Seattle, were described in terms of the number, size and location of earth stations. By using sub-nodal information to locate earth stations within an SMSA, the number, size and location of earth stations for the entire SMSA were compared with that postulated by the nationwide traffic distribution model and appropriate modifications were made in the model.

An example of the output from this task is indicated in Tables 3-13 and 3-14, and Figure 3-3. Table 3-13 shows the number of each type of earth station projected by the model for Denver. Figure 3-3 indicates the concentration of earth stations as determined by the secondary and primary record. Table 3-14 lists the number of each type of earth station for each subnode (i.e., zip code area). The nationwide model projected all earth stations within a 12 mile radius as did the intra-urban topology.

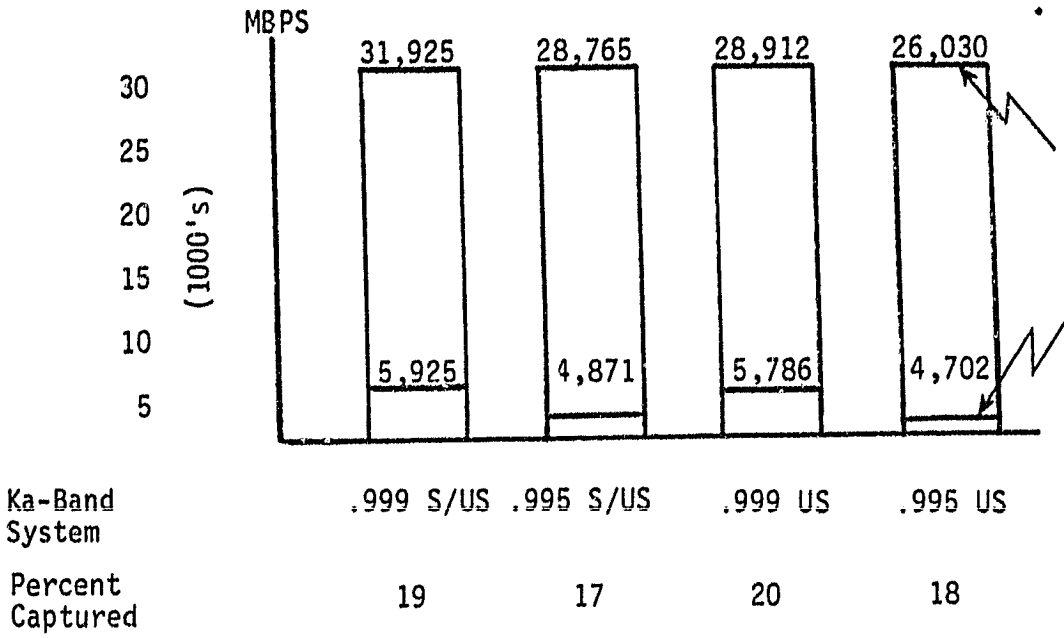


FIGURE 3-2. ADDRESSABLE AND ACCESSIBLE (CAPTURED) TRAFFIC

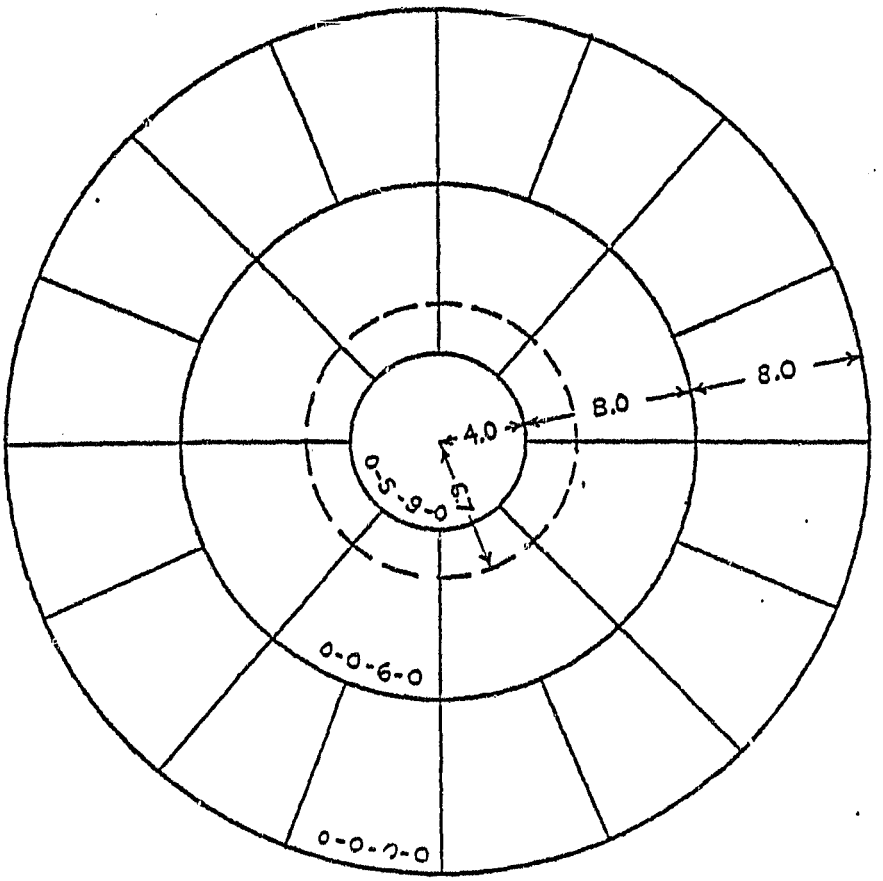
TABLE 3-13. EARTH STATION PROJECTIONS FOR DENVER

DENVER-BOULDER CO TOTAL TRAFFIC: 172.58

CAPTURED TRAFFIC: 58.50

	LRG		MED		SML		MINI	
RING	NODE	TOT	NODE	TOT	NODE	TOT	NODE	TOT
1	0	0	5	5	9	9	0	0
2	0	0	0	0	6	48	0	0
3	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0
		0		5		57		2

* RADII IN MILES, DOTTED LINE REPRESENTS CENTRAL CITY



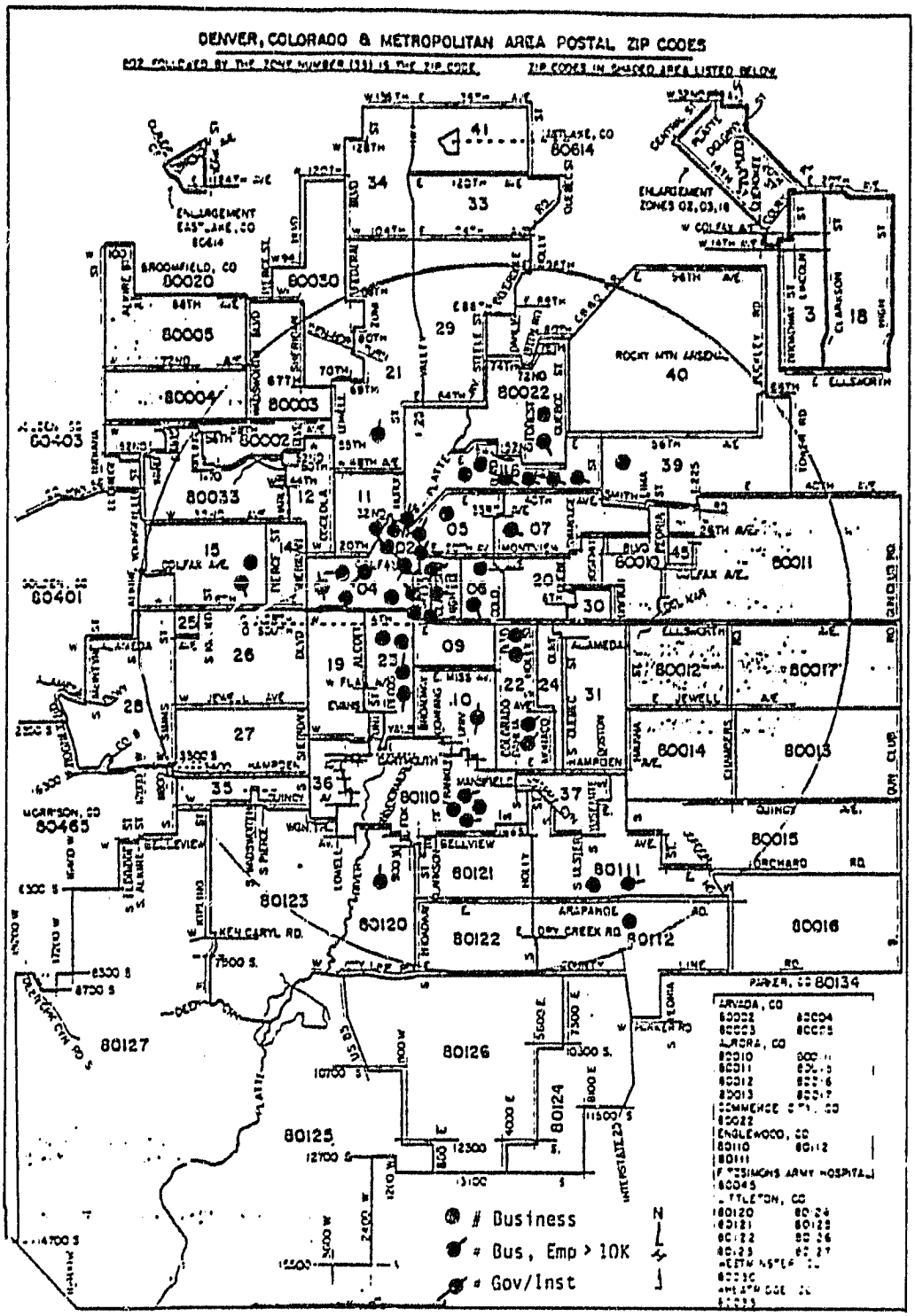


FIGURE 3-3

INTRA-URBAN TOPOLOGY MAP

TABLE 3-14. DENVER
INTRA URBAN TOPOLOGY

(Configuration: Shared/Unshared: Availability .999)

Distribution of Earth Stations by Zip Code:

Criteria:
1. Number of Businesses
2. Number of Busineeses with more than 10,000 employees
3. Number of major Government agencies and institutions

ZIP CODE	EARTH STATION SIZE		
	MEDIUM	SMALL	MINI
80202	1	9	
80203	1	6	
80216	1	6	
80204	1	4	
80222	1	3	
80223		7	
80110		7	
80206		2	
80215		2	
80022		2	
80111		2	
80112		1	1
80239		1	1
80205		1	
80207		1	
80120		1	
80221		1	
80210		1	
	5	57	2

SECTION 4
SUMMARY AND CONCLUSIONS

- The demand for telecommunications in general and for satellite telecommunications in particular will increase significantly between now and the year 2000.

- Voice services over the period will continue, by wide margins, to account for the largest portion of the overall demand for telecommunications in general, and for satellite telecommunications in particular.

- While the largest portion of the overall satellite demand will be for voice communications, the largest portion of the CPS segment of the overall satellite demand will be for data communications.

- The Ka-band system with the shared/unshared configuration and .999 availability level will be the Ka-band CPS satellite system that will have the largest amount of addressable and accessible (capturable) traffic.

- As with the CPS traffic forecast, the largest portion of the Ka-band CPS forecast will be demand for data communications.

- About half of the Ka-band CPS traffic will be for business communication, a third for institutional communications and a sixth for government communications.

- A majority of Ka-band CPS traffic will be transmitted between 150 and 1000 miles.

- A typical nationwide Ka-band CPS network will capture about 20 percent of the Ka-band CPS addressable traffic.

- The growth rates for satellite traffic will be several percentage points greater per year than will the growth rate for telecommunications in general.

- The CPS segment of the overall satellite traffic will grow several percentage points faster than the trunking or FCS segment, although the trunking segment will remain significantly larger than the CPS segment.

- Major assumptions were made throughout the study and these should be carefully reviewed when examining each forecast.

- Because varying the assumptions underlying the forecasts could significantly alter the forecasts, a sensitivity analysis is needed to determine the potential impact on the forecasts of varying such assumptions.

SECTION 5
ORGANIZATION OF STUDY REPORT

The report for this study consists of three volumes:

a. Volume I - Executive Summary
b. Volume II - Main Text
c. Volume III - Appendices

The Main Text details the purpose, tasks and methodology and provides major and specific findings. The Appendices present comprehensive and detailed explanations of methodologies and include specific tables of forecasts that are summarized in the Main Text.

The Main Text, Volume II, includes the following sections:

a. Section 1 - Overview
b. Section 2 - Potential CPS Telecommunications Services
c. Section 3 - Potential CPS User Classes
d. Section 4 - Comparative Economics
e. Section 5 - Baseline Forecasts
f. Section 6 - Impacted Baseline Forecasts
g. Section 7 - Net Long Haul Forecasts
h. Section 8 - Overall Satellite Forecasts
i. Section 9 - CPS Satellite Forecasts
j. Section 10 - Ka-band CPS Satellite Forecasts
k. Section 11 - Nationwide Traffic Distribution Model
l. Section 12 - Intra-Urban Topology

The Appendix, Volume III, includes the following sections:

a. Appendix A - Baseline Forecasts
b. Appendix B - Impacted Baseline Forecasts
c. Appendix C - Market Distribution Model
d. Appendix D - Potential CPS User Classes

e. Appendix E - Net Long Haul Forecasts
f. Appendix F - CPS Cost Analysis
g. Appendix G - Overall Satellite Forecast
h. Appendix H - CPS Satellite Forecast
i. Appendix I - Ka-Band CPS Satellite Forecast
j. Appendix J - Nationwide Traffic Distribution Model
k. Appendix K - Intra-Urban Topology

When the study discussed in these three volumes was completed, additional related work was begun. A sensitivity analysis was initiated to determine the effects on the forecasts (i.e., those presented in Volumes 1-3) of varying selected key assumptions. The results of this follow-up effort will be presented in a separate report that will be available about six months after the release of Volumes 1-3.